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Book Review

Remagnetization and Chemical Alteration of Sedimentary Rocks, Eds. R. D. Elmore, A. R. Muxworthy, M. M. Aldana and M. Mena, Geological Society Special Publication N.371, The Geological Society London, 2012; ISBN: 978-1-86239-351-6

Marek Lewandowski[1]

Paleomagnetism is known as a source of data used for studies on the history of geomagnetic field and plate tectonic reconstructions. However, its applications in geophysics and geological sciences are much wider. During the last two decades, paleomagentism took a new breath from fast developing hydrocarbon exploration, showing its applicability in better understanding of underground reductive fluids flow. The current Special Publications focuses on chemical remagnetization and changes of magnetic minerals, genetically associated with hydrocarbon migration through sedimentary rocks. This is a key issue, since remanence recorded in secondary magnetic phases can be dated by comparison with reference paleomagnetic data. This, in turn, allows for a better planning of ventures in mineral resources exploration. Gathering articles from top-class scientists, this monographic volume is an excellent review of the current state-of-the-art in fundamental paleomagnetic problems related to diagenesis and origin of the natural remanent magnetization, setting a stage for better cooperation between academia and the oil industry.

Remagnetization and chemical alteration of sedimentary rocks are discussed by Elmore, Muxworthy and Aldana in the introductory paper. The authors provide a general overview, and review the current knowledge of the chemical remagnetization mechanism. Discussed are roles of external fluids, origin of syntilting chemical remanence, and rock magnetic characterization of chemical remagnetization. The second paper by Van der Voo and Torsvik describes the development of understanding on remagnetization of sedimentary rocks, beginning from the first papers on this topic dating back to the 1950s. Special attention is given to hematite and magnetite, and their role in recording remanent magnetization in red beds and carbonates, respectively. Particularly valuable (especially for researchers looking for good themes for their grant applications) are the conclusions, which provide a list of the most important scientific problems to be solved. Review of rock magnetic methods applied in studies on magnetite, or ways of secondary remanence dating, are also presented. The third paper, on episodic remagnetization related to tectonic events and the consequences for the South America polar wander path, has been treated carefully by Font, Rapalini, Tomezzoli, Trindade and Tohver. Existing Ediacaran-to-Cretaceous Apparent Polar Wander Paths (APWP) of South America are envisaged, focusing on problems of dating of their key Ediacaran/Cambrian, late Palaeozoic and Cretaceous sectors. A summary on areas subjected to remagnetization in South America ends this excellent paper.

In the next publication, palaeomagnetism of the Mississipian Barnett Shale of the Fort Worth Basin, Texas, is explored by Dennie, Elmore, Deng, Manning and Pannalal. The paper, analyzing four palaeomagnetically oriented cores, specifically tests the hypothesis that the Barnett Shale formation has been altered by externally derived fluids, and that these processes caused remagnetization. The analyzed palaeomagnetic record helps in better

[1] Institute of Geological Sciences, Polish Academy of Sciences, Twarda 51/55, 00-818 Warsaw, Poland. E-mail: lemar@igf.edu.pl

understanding a causal relationship between fluid migration and maturity of the shales, as well as to date this process. In the following study, samples obtained from a core drilled in Manitoba, Canada were analyzed by Szabo and Cioppa. They identified multiple magnetizations in Ordovician-Devonian carbonates in the Williston Basin, and date them by comparison of the paleomagnetic and rock magnetic properties to those of younger formations of the Silurian and Devonian ages. The results of a multidisciplinary investigation of complex remagentizations within the Southern Canadian Cordilliera are presented by Zechmeister, Pannalal and Elmore. Detailed, integrated paleomagnetic, geochemical and petrographic studies have shown how palaeomagnetic analysis of rocks from fold-and-trust belt can provide useful information on timing of diagenetic events related to orogenesis. The next paper by Evans, Elmore, Denni, and Dulin deals with remagnetization of the Alamo Breccia, Nevada. The overall objective of this study was to investigate how brines flow through rocks and cause remagnetizations. A specific target for this study is Alamo Breccia, which could potentially be a conduit for remagnetizing fluids that caused widespread remagnetization in the Basin and Range area. This hypothesis was tested using paleomagnetic, geochemical and petrological methods.

In the following article, Appel, Crouzet and Schill provide a review on pyrrhotite remagnetization in the low-grade metamorphic rocks of the Tethyan Himalaya and its tectonic and tectonometamorphic constraints. The paper shows the usefulness of secondary remanence for deciphering the history of orogenic belts, and provides suggestions on further possibilities and targets of future paleomagnetic studies. Burial, claystones remagnetization and potential consequences for magnetostratigraphy are explored using laboratory technics by Aubourg, Pozzi and Kars. The results of the experiments make it possible to establish a model of greigite-magnetite-pyrrhotite geochemical transformations related to burial. Complex analytical studies from Eastern Colombian lithofacies are presented by Constanzo-Alvarez, Aldana, Bayona, L¢pez-Rodrigez, and Blanco. This paper aimed to study rock magnetic characterization of early and late diagenesis in a stratigraphic well from the Llanos (Argentina) foreland basin. In the paper by Mena and Walter, rock-magnetism methods were used on drill cuttings from a hydrocarbon exploratory well in Golfo San Jorge Basin (Argentina), to investigate the correlation between magnetic and petrophysical well data. Another look at the rock magnetism of remagnetized carbonate rocks is deliberately presented by Jackson and Swanson-Hysel. The authors critically discuss current views on the origins of the secondary remanence and its carriers. The paper reviews as-of-yet unresolved questions, regarding the nature of the grain-scale anisotropy, or the role of pyrrhotite in recording secondary components in carbonates. On the basis of new results from the Devonian carbonates of the Helderberg Group (New York State, USA) and reanalysis of a previous hysteresis loop, they conclude on the importance of particle-size distribution pattern as an indicator of magnetite authigenesis in carbonates.

In a following paper, a brief review of end-member modeling of an induced remanent magnetization (IRM) acquisition is presented by Dekkers. Using examples from limestones of Taurides Mts (Turkey), the author concludes that end-member modeling is helpful to discriminate between remagnetized and not-remagentized limestones. The very last paper, by Manning and Elmore, discusses the usefulness of standard rock magnetic methods in identification of magnetic phases, setting a platform for integrated palaeomagnetic and diagentic study, which will investigate the origin of the remanent magnetization and the diagenetic history of the Marcellus Shales in the Valley and Ridge province (USA).

The case studies in this volume are excellent examples of a top-level paleomagnetic kitchen. They show the potential of paleomagnetism, benefitting from development of modern methods in solid state analyses, such as energy dispersive X-ray, electron microscopy, or cryogenic magnetometers, and how it may contribute to hydrocarbon prospection. Several papers present results from drill cuttings in cooperation with oil companies, showing promising development with mutual links.

The volume includes informative and legible, black and white and color figures. The index of terms also includes references to table and figures. The

book will be useful not only to paleomagneticians, but also to geochemists, petrologists, structural geologists and sedimentologists.